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Saving money with effective in-line filters

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The Intensive care unit at Umeå Regional Hospital has during the past year, 1988, used PALL ELD 96 inline-filters on all patients with a central venous catheter. Two different time-periods were investigated, one when inline-filters were used and one without in-line filters. By counting the amount of intravenous disposables that were used and with TISS registration (therapeutic intervention scoring system) which is registered daily on all patients, cost and savings were derived 'per occupied bed day'. The study shows that through using in-line filters which are changed every 96 hours we may save approximately £35,000 every year.

INTRODUCTION

There are effective in-line filters on the market to be used for a longer period than 24 hours. When a filter was introduced by Pall Biomedical Ltd, which is the first filter that reduces the amount of particles, bacteria, air and endotoxins for up to 96 hours (Baumgarther et al 1986; Pall Biomedical 1986; Speilberg & Martin 1985) the thought arose that it might be possible to save money (Harrigan 1985; Cousins 1988) as well as create better patient safety.

Intravenous administration systems were previously changed on a daily basis or with every new infusion. With this in-line filter one may save the administration-sets for up to 96 hours. Airbubbles (Harrigan 1985; Marshall, 1987), particles (Allcutt et al 1983; Blackhouse et al 1987; Harrigan, 1985; Lowe, 1981; Marshall & Geoffrey 1987), undissolved drugs (Allcutt et al 1983; Marshall & Geoffrey, 1987) and endotoxins (Baumgartner et al 1986; Marshall & Geoffrey 1987; Speilberg & Martin 1985) would hereby be prevented from entering into the patient. The time taken in preparing intravenous administration systems was also decreased (Cousins 1988).

Infusion filters should be used when large volumes, many additives, long term treatment with intravenous fluids and/or a great number of intravenous injections are needed. A filter rating of 0.22 micron means that no particle bigger than 0.22 micron will pass through and enter the patient.

When this in-line filter was presented to staff in the Umeå Intensive Care Unit (ICU) many were not interested at all to begin with. However through reading and searching for articles about the matter it became evident that there were many reasons which provided motivation for the use of in-line filters.

In the Umeå ICU patients receive lots of assorted particles through infusions and injections. Approximately 2 million particles over a 24-hour-period are given to every average ICU patient (Mehrkens et al 1977). The clinical effects on the patients' total system (Ryan et al 1973) as well as locally (Allicutt et al 1983;

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Table 1
Disposables for intravenous therapy in the ICU, Umeå

Item	Supplier	Cost £
Solution set L76	Triplus	0.57
Solution set L76 3.2 m line	Triplus	0.82
Blood set	Triplus	0.52
Infusion set for pump STC-503	Terumo	1.55
3-way stopcock	Kemi-Braun	0.22
3-way stopcock with 10 cm extension tube	Viggo	0.43
3-way stopcock with 50 cm extension tube	Viggo	0.66
Ramp of four 3-way stopcocks with 150 cm extension tube	Vygon	2.56
Volume infusion set G62603	Ivac	5.28
Volume infusion set G52503	Ivac	3.56
Syringe extension set with occlusion sensing disc G30402	Ivac	0.91
Syringe 50 ml	Ivac	0.93
Pediatric solution set	Triplus	3.27
Combistop Luer-lock	Viggo	0.04
In-line filter 0.22 micron	Pall	6.41

Price according to 31.12.88
Exchange rates £1 = 10.76 SEK, 5 May 1989

Falchuk et al 1985, Marshall & Geoffrey 1987) are well recognised.

Intravenous fluid filtration is still not as common as in Sweden as in Great Britain and USA.

Through this article it is proposed to show the economic savings made possible by using a 96 hour filter in the daily routine.

METHODS

Two time periods were chosen for comparison: 17.10.88–17.12.88 while intravenous systems were changed daily, and 17.12.88–16.01.89 when the new filters were used and intravenous systems changed each 96 hours.

After counting the stored intravenous disposables in the ward before and after the respective time periods (17.10.88–17.12.88, 17.12.88–16.01.89) and through data from hospital computer lists, what were actually used and the cost for every individual item (Tables 1, 2, 3) was identified.

All patients admitted to the ICU at the Regional Hospital of Umeå (RiUm) are registered by computer. From the TISS (Therapeutic Intervention Scoring System) registration all necessary data were derived.

At ICU admission the patients are assigned to a specific diagnostic category according to APACHE II (Acute Physiology and Chronic Health Evaluation) and are defined ICU patients, while patients admissioned to the ICU because recovery room is closed or full and not in need of intensive care treatment are defined for the purpose of this article as post-operative patients. The length of time in the ICU is short for these patients and the use of intravenous disposables is minimal, so these patients were excluded from the study which was focused on the ICU patients who have the greatest demand for intravenous disposables. The total cost of these disposables was compared with the total number of occupied bed days for ICU patients which gave cost respective savings 'per occupied bed day'.

The infusion filters were only used on patients with CVCs (central venous catheters), hence intravenous disposables used with patients who had peripheral catheters were changed daily.

The number of inserted CVC's during both periods are shown in Tables 4, 5.

All ICU nurses received both oral and written information about the filter with reference articles to read, which motivated the use of in-line filters.

To reduce the risk of contamination all clear liquids and drugs pass through the filter except those with molecule size which is too large, for example;

Table 2
Cost of Iv disposables with in-line filter in ICU, Umeå 17.10.88–17.12.88

Product	Number used	Cost £
Solution set L76	1941	1106
Solution set L76 3.2 m line	2	2
Blood set	327	170
Infusion set for Terumo pump	216	335
3-way stopcock	938	206
3-way stopcock with 10 cm extension tube	458	197
3-way stopcock with 50 cm extension tube	108	71
Ramp of four 3-way stopcocks with 150 cm extension tube	93	238
Volume infusion set G62603	388	2049
Volume infusion set G52503	90	320
Syringe extension set with occlusion sensing disc G30402	220	200
Syringe 50 ml	370	344
Pediatric solution set	46	150
Combistop Luer-lock	9171	367
In-line filter 0.22 micron	383	2455
Total cost		£8210
Occupied bed days during the period (ICU patients)		463
Cost per occupied bed day (ICU patients)		£18

blood products: concentrate of erythrocytes etc
plasma and albumin
fat emulsions: Intralipid®
diazepam for injection
propofol

Typical intravenous administration system in ICU with a central venous catheter at Umeå University Hospital (Fig. 1).

RESULTS

Comparative itemised costs with and without use of the in-line filter are shown in Tables 2 and 3.

Despite the short time period used for counting the usage and savings, results show that it is possible to actually save money although the patients with CVC are only 51% and 69% re-

Table 3
Cost of Iv disposables without in-line filter in ICU RiUm 17.12.88–16.01.89

Product	Number used	Cost £
Solution set L76	583	332
Solution set L76 3.2 m line	8	7
Blood set	120	62
Infusion set for Terumo pump	30	46
3-way stopcock	882	194
3-way stopcock with 10 cm extension tube	294	126
3-way stopcock with 50 cm extension tube	62	41
Ramp of four 3-way stopcocks with 150 cm extension tube	376	963
Volume infusion set G62603	265	1399
Volume infusion set G52503	58	206
Syringe extension set with occlusion sensing disc G30402	88	80
Syringe 50 ml	131	122
Pediatric solution set	21	69
Combistop Luer-lock	3625	145
Total cost		£3792
Occupied bed days during the period (ICU patients)		131
Cost per occupied bed day (ICU patients)		£29

Table 4
Inserted CVC's during 17.10.88–17.12.88

Number	Average time (days)	Total number of patients	% of all ICU patients (with CVC)
96	4.6	83	51

Table 5
Inserted CVC's during 17.12.88–16.01.89

Number	Average time (days)	Total number of patients	% of all ICU patients (with CVC)
52	3.5	43	69

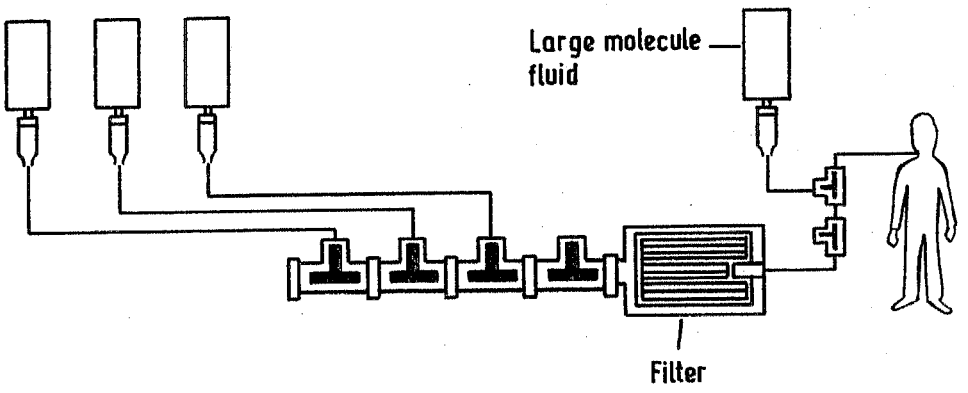

Fig. 1

Table 6
Savings concerning Iv disposables 'per occupied bed day'

Total number of occupied bed days (ICU patients) 1988	3202
Total number of ICU patients 1988	950
Calculated total cost per occupied bed day without in-line filter 1988	£29
Calculated total cost 1988 (ICU patients without in-line filter) 3202 × £29	£92,858
Calculated cost per occupied bed day with in-line filter 1988	£18
Calculated total cost 1988 (ICU patients with in-line filter) 3202 × £18	£57,636
Expected savings in total 1988 if in-line filters had been used	£35,222

spectively of the total number of ICU patients (Tables 4, 5).

With such a large ICU with very complicated patients longer stay, and more money is saved by using the filter. All ICU patients averaged 3, 4 occupied bed days per patient in 1988. Calculation shows that the unit would have saved over £35,000 in 1988 (Table 6) if in-line filters were used.

DISCUSSION

During the study period nurses learned a lot about pH interactions between different drugs

and drug incompatibility. Sodium phenytoin for intravenous injection (pH 9) for example creates precipitates with drugs of lower pH, as do barbiturates also. Earlier these precipitates were not seen and maybe not recognized, and passed into the patient without being noticed.

When the filter was introduced on a larger scale in Spring-88, not everyone was convinced enough to use it daily. The main reason for this was maybe that it appeared that the flow rates were reduced quite quickly. So the filters were used more or less sporadically. During the succeeding months the attitude towards the in-line filter gradually changed to become more and more positive. Since the earlier routine was to change all intravenous disposables every 24 hours it did not 'feel right' to start saving these administrations sets for 96 hours.

According to a little survey done in the ICU (Strömberg & Wahlgren, 1988) between the two time-periods, all nursing staff wanted to use the in-line filter in the future.

The risk of small air bubbles is eliminated (Pall Biomedical, 1986), which is important, especially for little babies. For them a little air could mean a great risk and demand a great deal of time to extract it from the intravenous line. Air bubbles that are accidentally in the administration sets will enter the in-line filter but not pass into the patient.

Another thing not recorded, but received in strong impressions from colleagues (Strömberg & Wahlgren, 1988) is that also time used in preparing and changing administration sets can be saved when in-line fitters are used. This time was not quantified but appears to be considerable and allows time to perform other important duties.

SPRI's (The Swedish Planning and Rationalising Institute for the health and social services) manual of clinical nursing procedures page H 20: 1, 1989 recommends a daily change of infusion sets for patients with a central venous catheter. With in-line filters some of those risks mentioned by SPRI are eliminated.

An in-line filter will never replace a wise and sensible usage of intravenous administration sets.

The greatest challenge though, is to overcome nurses internal resistance against new routines that demand a little extra reading about new material and polypharmacy, creating enough information for the staff to be motivated not only to increase patient-safety but also to give economic savings and save time as well.

Acknowledgements

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References

Allcutt D A, Lort D, McCollum C N 1983 Final inline filtration for intravenous infusions: a prospective hospital study. Br J Surg; 70: 111–13

Backhouse C M, Ball P R, Booth S, et al 1987 Particulate contaminants of intravenous medications on infusions. J Pharm Pharmacol; 39: 241–5

Baumgartner T G, Schmidt G L, Thakker K M, et al 1986 Bacterial endotoxin retention by inline intravenous filters. Am J Hosp Pharm; 43: 681–4

Cousins D 1988 Cost savings in IV therapy. Care Crit Ill; 4 no. 1

Falchuk H K, Peterson L, McNeil B 1985 Microparticulate-induced phlebitis. N Engl J Med; 312: 78–82

Harrigan C A 1985 Care and cost-justification of final filtration. NITA; 8 no. 5

Lowe G D 1981 Filtration in IV therapy. Part 1: Clinical aspects of IV fluid filtration. Br J Intrav Ther; 2 March

Maki D G, Goldman D A, Rhame F S 1973 Infection control in intravenous therapy. Ann Int Med; 79: 6

Marshall L, Geoffrey L 1987 Intravenous fluid filtration. Care Crit Ill; 3: 10–17

Mehrkens H.-H, Klaus E, Schmitz J E 1977 Möglichkeiten materieller verunreinigungen durch zusatzinjektionen. (Possibilities of material impurities by additional injections) Klin Anästh Intensivther Band 14

Pall Biomedical Ltd. Information leaflet: Pall Intravenous Set Saver 1986 Pall Biomedical Limited, Europa House, Havant Street, Portsmouth PO1 3PD, England

Ryan P B, Rapp R P, DeLuca PP, et al 1973 In-line filtration—A method of minimizing contamination in intravenous therapy. Bull Parent Drug Assoc; 27: 1–13

Spielberg R, Martin J August 1985 Evaluation of the endotoxin/bacterial retention capabilities of IV filters during simulated extended infusions. Pall Corporation, Glen Cove, New York 11542

Strömberg C, Wahlgren J Dec. 1988 In-line filter or not—that is the question. Survey to all ICU nurses at the Regional Hospital in Umeå, Sweden